PHYSIOLOGY OF THE EYE
AND EYE HYGIENE
A Syllabus for Teachers, by
Florence Henderson

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EDUCATION 280

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PREFACE

The influence of visual defects and visual anomalies on the all-round development of the child has been one phase which has been sadly neglected in the many and varied studies which have been made in the field of child development. With the exception of the blind children in our schools all achievement is dependent on the organs of seeing. Europeans have called our schools reading schools and justly so, yet our educators have neglected to give a rightful place of importance to the study of the eye with the many psychological and educational implications.

There is a definite need for experimental study and scientific research in this field. There is further need for a clear and simple statement of the problems which arise in connection with the eye to which the teacher can turn as a means of helping her to an understanding of that important part of the child's anatomy with the educational implications of the place of the eye in the all-round development of the child.

One purpose of this handbook is to provide a simple orientation to the subject as a whole which should be of help to teachers. It should further prove as a means of reference for the administrator, teacher, and sight conservation teacher. It is the purpose of the author not only to state in simple terms the eye diseases, functional disorders and other anomalies which affect visual acuity but to provide a statement of the psychological and educational implications of each with a statement of the role of the teacher in meeting the need.

The teacher of the regular classes should be familiar with the structure and development of the eye, the effect of size of print and lighting. She should be aware of the effect of emotional strain on the visual apparatus. The anatomical changes which affect children's

eyes should also be known and used in the planning of the curriculum to fit the needs of children. Yet how seldom is it a part of educational planning. Adults plan and in some instances "go overboard" on the subject of visual aids and their use in the classroom. Courses on visual aids are hurriedly written into the credential requirements and yet a study of that which makes all this possible is entirely ignored. Adults plan this continuous program of visual stimulation without a thought as to the effect on that most adaptable part of the human mechanism. That its adaptability is such, is taken for granted or entirely ignored, no attention being given to the results. Teachers continue to plan their programs without a thought to eye rest periods and to arrange the physical environment with what may be an "eye" to the artistic but not to the care of the eyes. Luella Cole, in her book, "The Psychology of the Adolescent,"[1] makes the statement that an ever-increasing number of children have visual defects of one form or another and this increases steadily through the school years. Civilization has imposed this upon us, but teachers and those interested in the welfare of children and in whose care the educational planning is placed should take cognizance of this fact and not wait for fifteen or twenty years to make an experimental study of the results of our misuse and misplanning.

An integral part of each teacher's training should be knowledge of structure of the eye, its care, visual anomalies which affect visual acuity, and what constitutes an adequate testing program. It is hoped that this handbook will help the teacher of regular classes to become aware of the problem and to help in its solution. It is further hoped that it will prove an aid to the teacher of sight conservation as a means of orientation to her special field and a means of reference.

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1. Luella Cole, Psychology of Adolescence, Farrar and Rinehart, New York, 1945.

CHAPTER I

CLARIFICATION OF TERMS

In functional education we say that we learn by doing. In this study of the eye it should follow that we do not stop by the way to give definitions and tell about what we are going to do but to plunge directly into the use of terms which will by use become familiar. This would be the only right way to proceed if this were a laboratory course. Being a handbook which of necessity becomes a means of reference, we must stop and clarify the terms which will be used throughout. Some of the terms have taken on a new meaning due to scientific study and research, some are and very likely will remain the same. One must learn to evaluate carefully all material here given and to check it against the most reliable sources. The attempt has been made to do just this but it is suggested that as in everything else which is a developing science one should add, delete, and revise frequently. It is hoped that this study will inspire the student to become familiar with the best periodicals in this line and which provide authentic research against which to check one's vocabulary.

ACCOMMODATION, adaptation of eye for near vision by contraction of the ciliary body which increases the refractive power of the crystalline lens.

ALBINISM, congenital absence of pigment in the skin, hair, iris and choroid; usually associated with nystagmus, photophobia and astigmatism.

ALTERNATING SQUINT OR STRABISMUS, a form of cross-eye in which sometimes one eye and at other times the other is out of line.

AMAUROSIS, blindness, especially that form associated with an organic condition of the eye.

AMBLYOPIA, poor vision or loss of visual acuity.

AMBLYOPIA EX ANOPSIA, poor vision or loss of visual acuity, without any apparent disease of the eye.

AMETROPIA, refractive defect which prevents the eye in a state of rest from focusing the image of distant objects upon the retina; includes hyperopia, myopia and astigmatism.

ANTRUM OF HIGHMORE, a cavity in the upper jaw bone, also called the antrum or maxillary sinus.

ATROPHY, OPTIC, degeneration of the optic nerve.

ATROPHIC EYEBALL, degenerated sightless eyeball.

BASEDOW'S DISEASE, exophthalmic goiter.

BI-CONVEX, two surfaces each of which is part of the outer surface of a sphere.

BINOCULAR, pertaining to both eyes.

BINOCULAR VISION, the ability to use the two eyes simultaneously to focus on the same object and to fuse the two images into a single image which gives a correct interpretation of its solidity and its position in space.

BITEMPORAL, pertaining to both temples, as bitemporal hemianopsia--blindness in the outer or temporal half of each visual field.

BLEPHARITIS, inflammation of the margin of the eyelids.

BLEPHAROSPASM, spasm of the orbicular muscle of the eyelids.

BLIND SPOT, the part of the visual field corresponding to that part of the optic fundus where the optic nerve enters is the physiological blind spot. In disease, it corresponds to an area in the retina which does not function.

BULBAR CONJUNCTIVIA, the part of the conjunctiva covering the anterior surface of the eyeball.

BUPHTHALMUS, large eyeball (infantile glaucoma). (ox eye)

C CC (CUM CURRECTION, with correction,i.e.,wearing lenses prescribed.

CANALICULUS, a small channel leading from the puncta at the inner angle of the eye to the lacrymalsac.

CANTHUS, the angle at either end of the slit between the eyelids, specified as outer, or temporal and inner, or nasal.

CARCINOMA, cancer, a malignant growth.

CATARACT, opacity or clouding of the crystalline lens or its capsule, or both.

CELLULITIS, an inflammation of soft tissues.

CENTRAL VISUAL ACUITY, faculty of the eye to perceive the shape or form of objects in the direct line of vision.

CHALAZION, a cyst or tumor of the eyelid from retained secretion of the Meibonian glands.

CHOKED DISC, marked swelling of the optic disc.

CHORIORETINITIS, inflammation of the choroid and retina.

CHOROID, the vascular tissue of the eye, lying between the retina and sclera, and continuous with the ciliary body and iris in front. It furnishes nourishment to the other parts of the eyeball.

CHOROIDITIS, inflammation of the choroid.

CILIA, eyelashes.

CILIARY BODY, portion of the vascular coat between the iris and the choroid. It consists of ciliary processes and ciliary muscles.

COLOBOMA, congenital cleft due to failure of the eye to complete growth in the part affected.

COMMISSURE, OPTIC, the union and crossing of the optic nerve.

CONCAVE LENS, a lens with hollowed surfaces like the inner aspect of a sphere; having the power to diverge the rays of light; also known as a reducing glass or minus lens, denoted by the sign -.

CONES, together with the rods, are receptors for the optic nerve; they are the light-perceiving layer of the retina; cones, concentrated at the macula, and decreasing toward the periphery, are concerned with sharp vision and perception of shape; are sensitive to color.

CONJUGATE MOVEMENTS, paired movements, thus when looking at the right, the external rectus muscle of the right eye pairs up with the internal rectus of the left eye.

CONJUNCTIVA, mucous membrane which lines the eyelids and covers the front part of the eyeball.

CONJUNCTIVITIS, inflammation of the conjunctiva.

CONTACT LENS, lens so constructed that it fits directly on the eyeball; used chiefly in connection with a cone-shaped cornea and high myopia.

CONVERGENCE, the act of bringing the two eyes inward as in looking at a near object.

CONVEX LENS, a lens with surfaces like those of part of a sphere, having the power to converge the rays of light and to bring them to a focus; also known as a magnifying, hyperopic or plus lens, denoted by the sign +.

CORNEA, the clear transparent portion of the external coat of the eyeball forming the front of the aqueous chamber; also known as the window of the eye.

CORNEAL ULCER, infiltration of a certain portion of the cornea, followed by suppuration and loss of substance and finally opacity of the spot.

CROSS-EYE, a form of strabismus or squint.

CRYSTALLINE LENS, a transparent, colorless body suspended in the anterior portion of the eyeball between the aqueous and the

vitreous chambers, the function of which is to bring the rays of light to a focus.

CYCLITIS, inflammation of the ciliary body.

CYLINDRICAL LENS, a lens with one surface which is a section of a cylinder (either concave or convex). A lens used for the correction of astigmatism.

CYCLOPEGIC, a drug which temporarily paralyzes accommodation and dilates the pupil.

CYST, a growth consisting of fluid within a capsule.

DACRYOCYSTITIS, inflammation of the lacrymal sac.

DARK ADAPTATION, the power of the eye to adjust itself to a dim light.

DEPTH PERCEPTION, the ability to perceive the solidity of objects and their position in space.

DIOPTER, unit of measurement of strength or refractive power of lenses. A lens of one diopter is a lens having a focal distance of one meter, a comparatively weak lens; a two-diopter lens is one having half the focal length of the one-diopter lens, or $\frac{1}{2}$ meter; a lens of a focal length of four meters is called an 0.25 diopter lens.

DIPLOPIA, double vision; one object seen as two; double images result when the visual lines of the two eyes are not directed toward the same object, i.e., when one eye deviates (unless the image of the deviating eye is suppressed).

DUCTION, a stem word used with a prefix to describe the turning or rotation of the eyeball (abduction, adduction).

ECTROPION, a condition in which there is an eversion (turning inside out) of the eyelids.

EMMETROPIA, a condition of normal refraction of the eye. The images of distant objects are focused exactly upon the retina when the eye is in a state of rest.

ENTROPION, a condition in which there is an inversion (turning inward) of the eyelid.

ENUCLEATION, complete surgical removal of the eyeball.

ETHMOID SINUS, the cavities or air cells within the ethmoid bones, behind the bridge of the nose.

ESOPHORIA, a tendency of the eye to turn inward.

ESOTROPIA, a manifest turning inward of the eye.

EXCITING EYE, in sympathetic ophthalmia, the injured eye from which the irido-cyclitis is transferred to the uninjured eye.

EXOPHORIA, a tendency of the eye to turn outward.

EXOPHTHALMUS, abnormal protrusion of the eyeball.

EXOTROPIA, abnormal turning outward from the nose of one or both eyes (divergent strabismus).

EXTERNAL RECTUS MUSCLE, one of the six extrinsic muscles of the eye; it moves the eye outward towards the temple.

EXTRINSIC MUSCLES, the six muscles which move the eye, namely the four recti and the two obliques.

EYE DOMINANCE, tendency of one eye to assume the major function of seeing, being assisted by the less dominant eye.

EYEGROUNDS, fundi or interior of the eyes, i.e., optic nerves, retina, etc.

FIELD OF VISION, the space in which a person can see while the eye is fixing or gazing steadily at a target in the direct line of vision, peripheral or indirect vision; the vision of the retina other than that of the macula.

FOCUS, a point to which rays are converged after passing through a lens; focal distance is the distance rays travel after refraction before focus is reached.

FORNIX, pocket or cavity made of a loose fold connecting palpebral and bulbar conjuctiva.

FOVEA CENTRALIS, the small depression in the macula opposite the visual axis (the lens). It is the most sensitive part of the retina, the point of clearest vision. At the fovea are only cones.

FUNDUS, the eye ground or posterior part of the eye within its coats; the interior of the eye as seen with the ophthalmoscope.

FUSION, the coordination by the brain into one image of the separate images formed on the retinas of the two eyes.

GLAUCOMA, a disease of the eye characterized by increased intra-ocular pressure: hardening of the globe; "hardening of the eyeball."

GLIOMA, See Retinoblastoma.

GONORRHOCAL OPHTHALMIA, infection of the eyes of the new born due to gonorrhoeal vaginitis in the mother; ophthalmia neonatorum.

HEMIANOPSIA, blindness of one-half the field of vision of one or both eyes.

HETEROPHORIA, a constant tendency of the eyes to deviate from the normal axis, counter balanced by simultaneous fixation forced by muscular effort (prompted by the desire for single binocular vision). Deviation is not usually apparent, hence is said to be "latent."

HETEROTROPIA (strabismus, squint), a manifest deviation of the axis of the eyes, making single binocular vision impossible, fixation is maintained with either eye, but not simultaneously with both.

HOLMGREN WOOL TEST, a test for color blindness based on the ability to match correctly wool samples from a set especially dyed in various shades and colors.

HORDEOLUM (stye), acute inflammation of a sebaceous gland in the margin of the eyelid, due to infection and usually resulting in the formation of pus; often appear in crops or series; frequently associated with a lowered state of health, anemia, and uncorrected errors of refraction.

HYPEROPE, a far-sighted person.

HYPEROPIA (farsightedness), a refractive error in which, because the eyeball is short or the refractive power of the lens weak, the point of focus for rays of light from distant objects (parallel light rays) is behind the retina; thus, the accommodation to increase the refractive power of the lens is necessary for distant as well as near vision.

HYPERTENSION, high blood pressure (due to disease of the arteries, kidney, or heart and other causes).

HYSTERICAL AMBLYOPIA, a form of temporary psychic blindness occuring in hysteria.

HYPERPHORIA, a tendency of one eye to deviate upward.

HYPERTROPIA, elevation of one of the visual axes.

INFERIOR OBLIQUE MUSCLE, one of the six extrinsic muscles of the eye; it moves the eye up and out and rotates it outward.

INFERIOR RECTUS MUSCLE, one of the six extrinsic muscles of the eye; it moves the eye down.

INTERNAL RECTUS MUSCLE, one of the six extrinsic muscles of the eye; it moves the eye inward towards the nose.

INTERSTITIAL KERATITIS, a form of inflammation of the middle layer of the cornea; found chiefly in children and young adults, usually

caused by transmission of syphilis from mother to unborn child.

IRIDECTOMY, the cutting out of a part of the iris.

IRIDOCYCLITIS, inflammation of the iris and the ciliary body.

IRIS, colored, circular membrane, suspended behind the cornea and immediately in front of the lens, which regulates the amount of light entering the eye by changing the size of the pupil.

IRITIS, inflammation of the iris; the condition is marked by pain, congestion in the ciliary region, photophobia, contraction of the pupil, discoloration of the iris, and is caused by injury, syphilis, rheumatism, gonorrhea, tuberculosis.

ISHIHARA COLOR PLATES, a test for color blindness; based on the ability to trace patterns in a series of multiculored charts.

KERATITIS, inflammation of the cornea; frequently classified as to type as "interstitial" or "phlyctenular."

KERATOCONUS, cone-shaped deformity of the cornea.

KERATOMALACIA, degeneration and softening of the cornea.

LACRIMAL GLAND, gland which secretes tears; it lies in the outer angle of the orbit.

LACRIMAL SAC, the dilated upper end of the lacrimal duct.

LACRIMATION, excessive secretion of tears.

LAGOPHTHALMUS, a condition in which the lids cannot be completely closed.

LENS, a refractive medium having one or both surfaces curved.

LEUCOMA OR LEUKOMA, a whitish opacity of the cornea.

LIGHT ADAPTION, the power of the eye to adjust itself to variations in the amount of light.

LIGHT PERCEPTION (L.P.), ability to distinguish light from dark.

LIMBUS, the junction of the cornea and the sclerotic or white of the eye.

MACROPHTHALMIA, abnormally large eyeball, resulting chiefly from infantile glaucoma.

MACULA or Macula Lutea (yellow spot), the small area of the retina which surrounds the fovea; with the fovea, it is the area of distinct vision.

MEIBONIAN GLANDS, sebaceous glands of the eyelids.

MEGALOPHTHALMOS, abnormally large eyeball resulting usually from infantile glaucoma.

MICROPHTHALMOS, eyeball congenitally abnormally small in all its meridians.

MIOTIC, an agent that causes the pupil to contract.

MONOCULAR, relating to one eye as opposed to binocular, which involves both eyes.

MULTIPLE SCLEROSIS, a degenerative disease of the brain and spinal cord.

MYDRIATIC, a drug which causes dilation of the pupil such as atropine or homatropine.

MYOPE, a near-sighted person.

MYOPIA, nearsightedness, a refractive error in which, because the eyeball is too long, the point of focus for rays of light from distant objects (parallel light rays) is in front of the retina; thus, to obtain distinct vision, the object must be brought nearer to take advantage of divergent light rays (those from objects less than twenty feet away).

NEAR POINT OF ACCOMMODATION, the nearest point at which the eye can perceive an object distinctly. It varies according to the power of accommodation.

NEAR POINT OF CONVERGENCE, the nearest single point at which the two eyes can direct their visual lines, normally about three inches from the eyes.

NEAR VISION, ability to perceive objects clearly at normal reading distance (usually considered to be approximately fourteen inches from the eyes).

NIGHT BLINDNESS, a condition in which the sight is good by day, but deficient at night and in any faint light.

NYSTAGMUS, an involuntary, rapid movement of the eyeball; it may be lateral, vertical, rotary, or mixed.

OCULIST, a physician who specializes in diseases of the eye; an ophthalmologist.

OCULUS DEXTER (O.D.), right eye.

OCULUS SINISTER (O.S.), left eye.

OCULUS UTERQUE (O.U.), both eyes.

OPHTHALMIA, inflammation of the eye or the conjunctiva.

OPHTHALMIA NEONATORUM, an acute purulent conjunctivitis in the newborn; gonorrhoeal inflammation of the eyes of the newborn from the vagina of the mother.

OPHTHALMOLOGIST, a physician who specializes in diseases of the eyes, an oculist.

OPHTHALMOSCOPE, an instrument with a source of illumination having a perforated mirror; used in examining the interior of the eye.

OPTIC ATROPHY, atrophy of the optic nerve.

OPTIC CHIASM, the crossing of the fibres of the optic nerves on the ventral surface of the brain.

OPTIC DISK, head of the optic nerve.

OPTIC NERVE, the nerve of sight; the second cranial nerve.

OPTICIAN, one who makes or deals in eyeglasses and other optical instruments. He fills a prescription for glasses.

OPTOMETRIST, one skilled in the measurement of the refraction of the eye for prescription of glasses.

ORBIT, the bony cavity containing the eye; the eye socket.

ORTHOPTIC TRAINING, fusion training, series of scientifically planned exercises for developing or restoring the normal fusion teamwork of the eyes.

PALPERAL, pertaining to the eyelid.

PANNUS, invasion of the cornea by infiltration of lymph and formation of new blood vessels.

PERIMETER, an instrument for measuring the field of vision.

PERIPHERAL VISION, ability to perceive presence, motion, or color of objects outside of the direct line of vision; the vision of the retina outside the macular.

PHLYCTENULAR KERATITIS, a variety of keratitis characterized by the formation of papules on the cornea; usually occurs in young children and may be caused by poor nutrition.

PHORIA, a root word denoting a latent deviation in which the eyes have a constant tendency to deviate from the normal axis.

PHOTOPHOBIA, abnormal sensitivity to light.

PILOCARPINE, a drug used in ophthalmology to contract the pupil and to reduce into ocular tension.

PINK EYE, a contagious inflammation of the conjunctiva.

POSTERIOR CHAMBER, the space between the iris and the crystalline lens where the aqueous humor is formed.

PRESBYOPIA, loss of accommodation due to sclerosis or hardening of the lens.

PROSTHESIS, the replacement of a human eye by an artificial one.

PTERYGIUM, a fold of mucous membrane consisting of subepithelial growth of vascular connective tissue of the conjunctiva which may extend into the cornea.

PTOSIS, a paralytic drooping of the eyelid.

PUNCTA, small openings on the inner surface of the lids at the nasal angle leading into the lacrymal ducts.

RECTI MUSCLES, four of the six extrinsic muscles of the eye, namely, the internal, external, superior and inferior rectus muscles.

REFRACTION, the optical adjustment of the eye when in a state of rest; the ability of the eye to bring parallel rays to a sharp focus on the retina; determination of refractive errors of the eye and their correction by glasses.

REFRACTIVE ERROR, a defect in the eye that prevents light rays from being brought to a single focus exactly on the retina.

REFRACTIVE MEDIA, the media of the eye having refractive power; includes cornea, aqueous, lens, and vitreous.

RETINA, thin nerve membrane by means of which we see, being an expansion of the optic nerve. It lies between the vitreous and the choroid.

RETINITIS, inflammation of the retina; it is marked by impairment of sight, poor vision, edema and exudation into the retina, and occasionally hemorrhages into the retina.

RETINOBLASTOMA, malignant growth, commonly known as glioma of the retina, probably always congenital, occurs in children, usually in one eye, at times in both, occasionally in successive children of same family.

RETINOSCOPE, an instrument for determining the refractive state of the eye by observing the movements of lights and shadows across the pupil by the light thrown onto the retina from a moving mirror.

RODS, together with the cones, are receptors of the optic nerve; the light perceiving layer of the retina; increase in number going from the fovea toward the periphery; are not differentially sensitive to various colors; stimulation of the rods produces only discriminations of grey.

SC, s (sine correction), without correction; that is, not wearing glasses.

SARCOMA, a malignant tumor.

SCLERA, the white fibrous coat of the eye; membrane, which with the

cornea, forms the external protective coat of the eye.

SCLERITIS, inflammation of the sclera.

SCOTOMA, a blind or partially blind area in the visual field.

SLIT LAMP, provides a narrow beam of light like a searchlight; often used with a corneal microscope for examination of the cornea.

SNELLEN CHART, a chart for testing central visual acuity, in which the letters or symbols are drawn to the Snellen scale of measurements, in such a way that the uppermost letter is designed to be read by the normal eye at 200 feet; rows of letters follow which should be read at 100, 70, 50, 40, 30, 20, 15, and 10 feet.

SPHERICAL LENS, segment of sphere refracting rays of light equally in all meridians.

STEREOSCOPE, an instrument for the fusion of two separate pictures in such a way as to produce a single picture having the appearance of solidity and length.

STRABISMUS, squint; failure of the two eyes to direct their gaze at the same object because of muscle unbalance.

STYE, see Hordeolum.

SUPERIOR OBLIQUE MUSCLE, one of the six extrinsic muscles of the eye; it moves the eye down and out and rotates it inward.

SUPERIOR RECTUS MUSCLE, one of the six extrinsic muscles of the eye; it moves it up.

SYNECHIA, adhesion of the iris to the crystalline lens or cornea.

TARSUS, the framework of connective tissue which gives shape to the eyelid.

TENSION, the intraocular pressure of the contents of the eyeball.

TONOMETER, an instrument for measuring ocular tension.

TRACHOMA, a chronic form of infectious conjunctivitis, which may also seriously affect other parts of the eye.

TROPIA, a root word denoting a manifest deviation from normal of the axis of the eyes (strabismus) used with a prefix to denote the type (heterophoria, esophoria, exophoria).

TOXIC AMBLYOPIA, poor vision secondary to poisoning of any kind.

TUNNEL VISION, contraction of the visual field to such an extent that only central visual acuity remains, thus giving the affected individual the impression of looking through a tunnel.

ULCER OF THE CORNEA, a loss of substance of the surface of the cornea secondary to infection.

UVEA, the iris, ciliary body and choroid.

UVEITIS, inflammation of the iris, ciliary body and choroid.

VISUAL ACUITY, central or direct vision for distance and near; the vision record which a person attains on a chart, usually the Snellen chart.

VASCULAR, of or pertaining to the blood vessels.

VISUAL PURPLE, a pigmentary substance in the retina reacting to light in such a manner as to produce nervous impulses which are interpreted finally as visual sensation.

VITREOUS, transparent, colorless mass of soft gelatinous material filling the eyeball behind the lens.

ZONULE OF ZINN, the suspensory ligament of the crystalline lens.

RESERVE SHELF: Duke-Elder, all; Hathaway 193-200; Kronfeld, all; May, all; Schwartz, 193-200; Tinker-Baker, 21, 22.

HORIZONTAL SECTION -- LEFT EYE

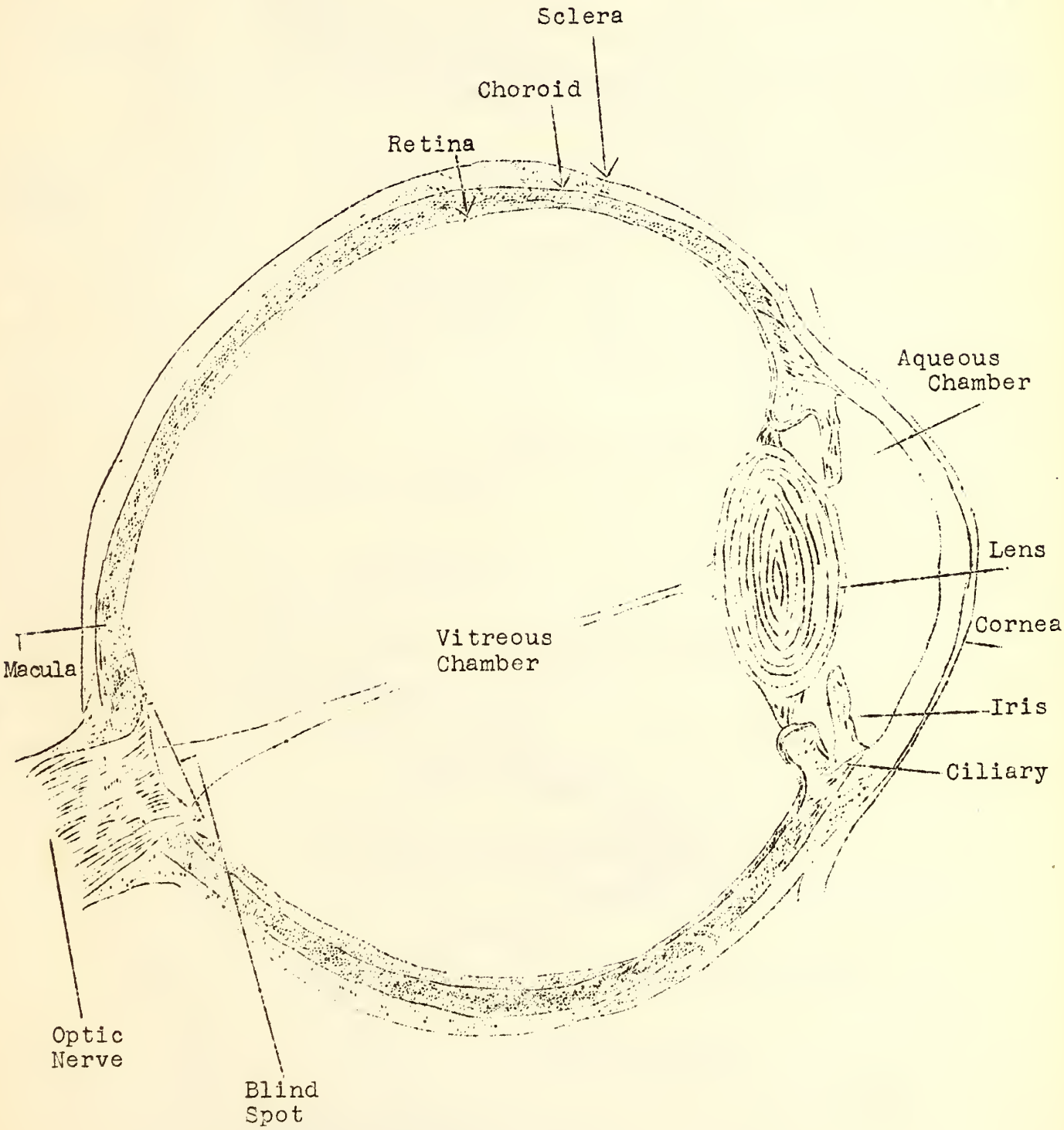
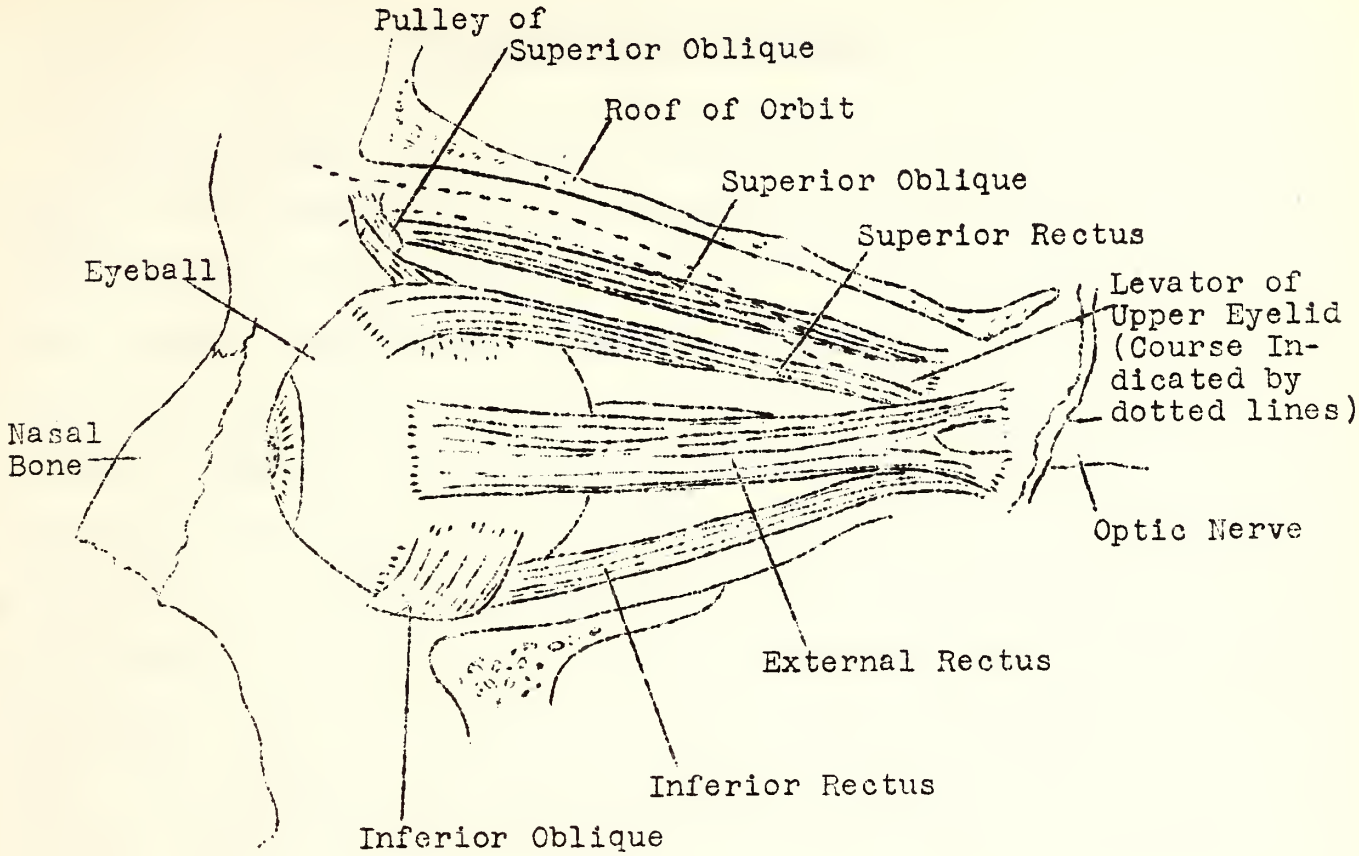


Figure 1.

EXTERNAL MUSCLES OF THE EYE



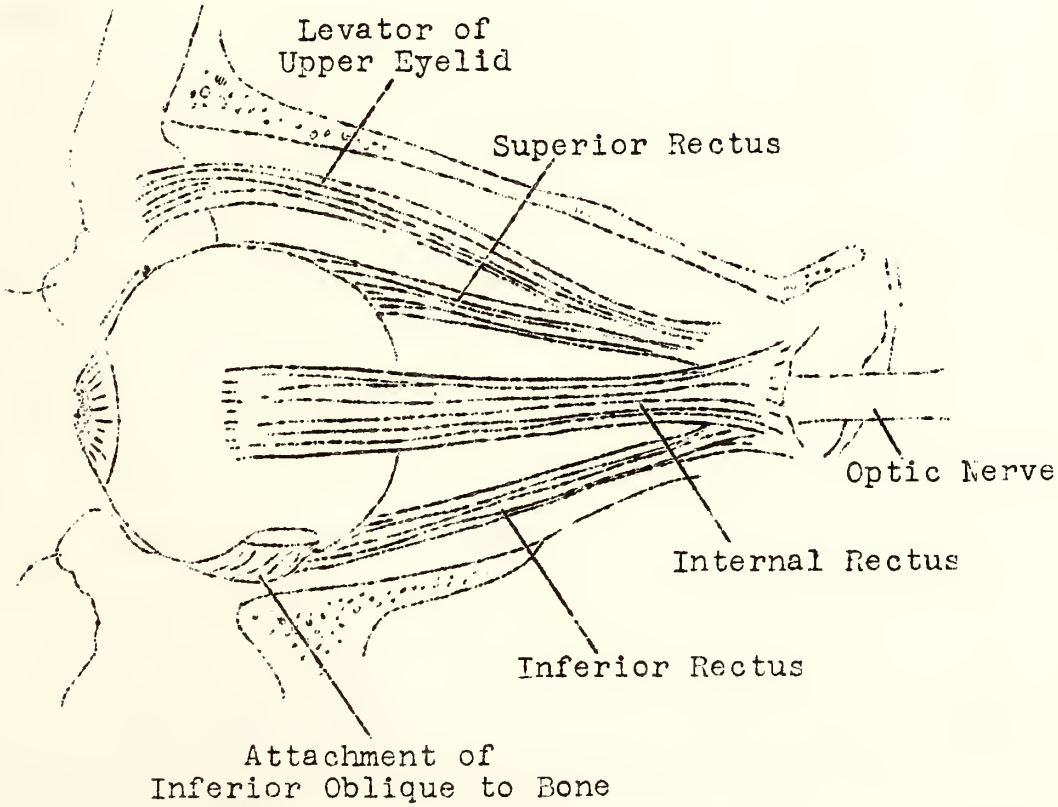


Figure 2.

CHAPTER II

THE STRUCTURE OF THE EYE

Woodworth says, "The eye is only part of the visual apparatus. The eyes are connected by their sensory nerves, the optic nerves, with the inner brain, and this in turn with the occipital lobes of both cerebral hemispheres. The occipital lobes do the observing. The eyes receive the stimuli, which produce nerve currents passing back to the inter-brain and cortex, and the cortex probably does all the grouping, patterning, and recognizing of objects."[1] All this intricate process of seeing and perceiving is entirely dependent upon the satisfactory functioning of the eyes. Therefore, it is of the utmost importance that we, as teachers, know as much as possible about the eye, its structure and functions so that we can aid in every way possible this grouping, patterning, and recognizing of which Woodworth speaks.

The eye has been compared to a camera. Addording to Fox,[2] it is far more than that. He says, "It is a far more efficient, labile, and useful instrument than any conceived by man. With it we make photographs on a sensitive retinal negative under extremes of light and shade where the most expensive camera would be useless. We change our focus automatically and instantaneously for distance or for near. We not only see better than animals--yes, even better than a cat in the dark--but our eye helps us to convey expression and emotion. We cry with it, which helps distinguish us from the lower species. With it we recognize fine gradations of color. Our field of vision is wider than that of any other living thing." Keeping all

1. Robert S. Woodworth, Psychology, Henry Holt and Co., New York, 1940, pp. 473, 474.

2. Sidney A. Fox, Your Eyes, Alfred A. Knopf, New York, 1944; p. 5.

this in mind, it is yet a convenient and simple way of remembering the parts of the eye to compare it to a camera. As eminent a psychologist as Woodworth says, "Comparing the eye with the familiar camera, we find that the outer tough white coat takes the place of the wood or metal of the camera box, while the black choroid coat, lining the sclerotic, corresponds to the coating of paint which blackens the inside of the camera box and prevents stray light from entering and blurring the picture. At the front of the eye, where light is admitted, the choroid gives place to the colored iris, with the hole in the center that we call the pupil of the eye. The iris has little muscle fibers in it, which regulate the size of the pupil; it corresponds to the adjustable diaphragm of the camera. The sclerotic gives place at the front of the eye to the curved, transparent cornea, which is a powerful lens. Just behind the pupil is another lens, adjustable in curvature by the action of the little ciliary muscle. This muscle corresponds to the focusing mechanism of the camera; by it the eye is focused on near or far objects."[3] This simple introduction may help us to proceed with our study of the structure of the eye and serve to remind us of the functions of these parts.

The eyeball itself is a ball or globe housed within a strong bony socket which protects it from injury. The over-hanging brow shields it from above. The nose and cheekbones guard it at each side and below. The lids shut instantly at the first hint of trouble and the tear gland is constantly supplying an antiseptic fluid to keep the eye fresh and moist. The development of the eyeball continues throughout life. Its length at birth is <u>three-fourths that of an adult</u>. In an adult it is about <u>an inch in diameter</u>, a bit longer from front to back

3. Robert S. Woodworth, <u>Psychology</u>, Henry Holt and Co., New York, 1940, pp. 474, 475.

than from side to side. It rests on a cushion of fatty tissue that makes its movements wonderfully easy and helps give it resiliency to absorb shocks.

"Each eyeball is moved in its socket by six muscles attached to the outside of the eye. These are called extrinsic muscles. Four of these, arising from a common point at the apex of the orbit, diverge to form a cone surrounding the posterior part of the globe and the optic nerve. One is attached to the top of the eyeball, one to the bottom, and the others to the two sides. Their function is to turn the eye up, down, and to either side. These are called the external, internal, superior and inferior recti. Another, the superior oblique muscle, also originates from the apex of the orbit, passes forward through a pulley at the anterior rim of the orbit, where it turns back and is inserted in the posterior side of the outer coating of the eye. The sixth muscle, the inferior oblique, comes from the anterior wall of the cavity and passes backward around the eye to be inserted in the upper part of the outer covering."[4] The function of these two muscles is to turn the eyes in oblique positions--up-and-in, up-and-out, down-and-in, and down-and-out. All the muscles must work in perfect coordination, not only with one another but also with the muscles of the other eye, in order to get the best results. If all are working in harmony, the eyes rotate freely in their orbits and in coordination with each other. (Fig. 2)

The eyes receive their blood supply from various branches of the ophthalmic arteries which in turn are derived from the internal carotid.

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4. Eye Health, Handbook for Nurses, Prepared by the National Society for the Prevention of Blindness, New York, 1946, pp. 11, 12.

There are three coats or coverings of the eye. The outer fibrous coat, which we spoke of above as the tough, white protective box of our camera, is the sclera. This covers the posterior 5/6 of the eyeball. It is opaque, firm fibrous membrane which maintains the shape of the eyeball. It has few blood vessels and is separated from the choroid coat by a lymph space. The cornea, the curving, transparent front of the eye set into the sclera like a watch crystal, is composed of firm, colorless fibrous tissue. It is well supplied with nerves and lymph spaces, but except in the limbus (area 1 mm wide encircling the cornea proper) has no blood vessels. Its nutrition is dependent upon diffusion of lymph from the nimbus. The curvature of the cornea is all-important to clear images; variations in the curvature of the cornea give us the refractive error which we call astigmatism. This curvature is slightly greater on the horizontal meridian than on the vertical. Its horizontal diameter reaches adult size early in life. The optical density is about the same as the aqueous, the clear, watery, fluid which fills the anterior and posterior chambers within the front part of the eye, and the vitreous, that transparent colorless mass of soft, gelatinous material filling the eyeball behind the lens. Perpendicular rays of light meeting the cornea at the center pass through in a straight line and oblique light rays meeting the cornea are deflected toward normal.

Lying within and next to the sclera is the thin, dark brown, vascular coat called the choroid. It consists of capillaries, veins, arteries, and pigment cells. Its function is primarily nutritive but it may share in regulating the intra-ocular pressure. The choroid extends forward to the ciliary body which encircles the lens and is attached to it by suspensory ligaments. The internal surface is continuous with the retina. The ciliary body consists of three parts.

The Pars Plana is a zone 4mm wide, continuous with the choroid. The ciliary processes, 70 to 80 pale radiating folds like a plaited ruffle around the margin of the lens, are similar in structure to the choroid but more vascular and secrete the nutrient fluid for the cornea, the lens and the vitreous. The ciliary muscle consists of three sets of fibres whose function is to pull forward the choroid coat and release tension on the ligaments attached to the lens. This is essential to accommodation. The iris is the circular disk behind the cornea and in front of the lens. It is practically continuous with the ciliary processes and connected to the sclera and cornea where they join one another. It serves to regulate the amount of light which enters the eye. In strong bright light the pupil shrinks to a small point; in dim light it enlarges. These changes are involuntary and brought about automatically by the expansion and contraction of the two sets of muscles of the iris, caused by the sensitivity to light. One set of these muscles encircles the pupil and is used to contract it, the other radiates from the pupil to the circumference and dilates the pupil. These three structures, the iris, the ciliary body, and the choroid constitute the uveal tract.

The innermost, transparent, exceedingly thin, yet highly complicated membrane is the retina. It is the most important agency for the transmutation of light into sight. All the other structures exist only to bring light upon the retina, so that we may see. It is attached to the choroid only at the entrance of the optic nerve and at the ora serrata which is the thinned out line where the retina terminates anteriorly. Aside from these two regions, the retina is not connected with the choroid, but lies loosely upon it. Hence, if blood or an exudate should lodge between the retina and the choroid, we have a separation of the retina from its natural bed. This con-

stitutes detachment of the retina. If we look into the eye at the retina, we note a small circle where the optic nerve enters the globe. This disc (white spot) is not exactly at the posterior pole but about 1/10 of an inch to the nasal side. Because the optic disc is the entrance of the nervous tissue, it has no light receptors (rods and cones) and therefore is a "blind spot." This is the point where the nerve fibres of the retina converge to form the optic nerve. A line which is in direct line of vision would pass through the center of the retina and emerge at the posterior pole of the eye. This region is called the yellow spot or macula. It is 2.08mm on the temporal side of the optic disc. In its center is a point, slightly depressed, called the fovea centralis, the point of sharpest vision. The blood vessels of the retina, the central artery and vein, enter the eye at the disc and immediately branch out and spread over the retina. However, the fovea centralis has no retinal arteries and is dependent for nutrition upon the vascular network of the blood vessels of the choroid. The retina itself is made up of ten super imposed strata of which the layer of rods and cones is the most important. The cones, approximately 3,600,000 in number decrease from the center of the retina, where there are only cones, towards the periphery, where the rods are more numerous. The function of the cones is the perception of color and form. They provide sharp vision and are more efficient in relatively bright light. The rods, approximately 7,000,000 in number, are sensitive to light and darkness. They furnish the mechanism for seeing in dim light. There are no rods in the fovea centralis, few in the macula, but they increase with the distance from the center. The rods are apparently not differentially sensitive to various colors. Stimulation of the rods produces only discriminations of grey. The visual purple, which despite its name has nothing to do with color vision, is a chemical substance

surrounding the rods. It appears to be important to rod functioning. It is bleached by light and regeneration depends on Vitamin A.

The refracting media within the eyeball consists of three parts. The first, the aqueous humor, is a clear, watery fluid filling the anterior chamber of the eye. It is believed to be derived from blood through capillary walls of eye tissues and leaves the eye by the Canal of Schlemm. The second, the vitreous humor, is a semi-fluid albuminous tissue enclosed in a thin membrane. It fills the posterior 4/5 of the eyeball. Its function is to support the retina and maintain the spheroid shape of the eyeball. Its refractive power is slightly greater than the aqueous but does not differ from water. The last and most important, the lens, is transparent structure, as colorless and clear as purest crystal, bi-convex and circular in form. The lens is held in place by the suspensory ligament, also known as the Zonula or Zone of Zinn, which is attached to the muscles of the ciliary body. When the ciliary muscles contract, the suspensory ligament becomes relaxed. Both the lens and the capsule are elastic so that when the tension is reduced, the lens becomes more convex, changing its refractive power and increasing its focal distance. In the optically normal eye, the lens does not change its shape for distant vision. For near vision, the front curvature is increased but the posterior remains unchanged. Early in life, the crystalline lens is quite elastic and can change its curvature quickly and easily, automatically adjusting the focus. When we are looking at distant objects the lens is almost flat, but when we do close work, the muscles of the lens contract, making it bulge and thus increase its magnification. The older the person the greater the amount of muscular effort required and the greater eyestrain. Whenever the lens or the capsule loses transparency we have cataract. The opacity may involve both

the lens and the capsule. We therefore speak of lenticular, capsular, or lenticular-capsular cataract.

Although we may know and be able to identify all the intricate parts of the eye with their functions, still it is not clear just exactly what sight is. Dr. Schwartz says, in his book, Your Eyes have Told Me, "We do not fully understand the process by which rays of light falling on the retina are converted into images. We know that light produces what is believed to be a chemical or electric change in the visual purple which converts it into a colorless substance. Simultaneously, pigment granules migrate from the posterior layer to the layer of rods and cones, probably for the purpose of replenishing the visual purple. The change in the visual purple sets up nervous stimuli in the rods and cones, and these stimuli are carried by the optic nerve fibers and optic tracts to the visual centers of the brain where they give rise to the sensation of light, in other words, sight."[5]

Although we may not know or fully understand what sight is, yet it should be our goal to try to know the essential facts concerning the structure and functions of that most intricate and interesting part of our anatomy, upon which we are so dependent. We will then more clearly understand those factors which interfere with our ability to use our eyes efficiently and comfortably. Such a study should bring us as teachers to a realization of the place of the eye in the all-round development of the child. We should realize the inter-relationship of the normal functioning of the eye to normal development of the child physically and mentally, for all that affects the eye affects the child as a whole and all that affects the child as a whole affects the eye. It should also bring before us the need for conservation of vision in this age when greater demands are put upon the organs of seeing than ever before in the history of man.

5. L.H.Schwartz, Your Eyes Have Told Me, Dutton Co., N.Y., 1945, p.40.

CHAPTER III

DISEASES OF THE EYE

"Because of the extent of which visual difficulties affect a child's life, a great deal of thought should be given to providing the child with opportunities for as normal a life as possible and for preventing or minimizing psychological trauma. In some cases the prognosis may be good, and there may be prospects of reasonably normal vision, but perhaps not for some period of time. In other cases the vision will remain poor permanently or may fail gradually or rapidly. Under any circumstances, the child has tremendous adjustments to make, either temporarily or permanently."[1] According to the Handbook for Nurses just quoted, teachers and all those responsible for the well-being of children should be informed as to visual anomalies which affect the child's sight. The teacher should know those diseases most common to the pre-school years which will affect the eyesight of her pupils. She should be familiar with, at least, the most common eye diseases and be informed as to the etiology and prognosis of these. The sight conservation class teacher should, of course, know the etiology and prognosis; she should know how to adapt the physical environment and the curriculum to fit the needs of children having any of these diseases. It is the purpose of this chapter to present those diseases with which the teacher should be familiar and which she is most likely to encounter among her pupils.

According to Dr. Charles A. Hargitt, malnutrition and unhygienic environment in childhood are conducive to the susceptibility of the eye to certain diseases. Among these may be mentioned ulcerative blepharitis. "This is readily recognized by the thickened lid margins,

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1. Eye Health: A Teaching Handbook for Nurses, Nat'l. Society for the Prevention of Blindness, New York, 1946, p. 68.

and the yellowish scales among the lashes. Some of these cases among the older children are probably associated with eyestrain and the need of glasses. If this condition is not promptly recognized and treated, it becomes chronic, resulting in permanently thickened lids with edges more or less everted. This means imperfect protection to the eyeball and may result in serious impairment of vision."[2] Any teacher who observes the symptoms mentioned above should report this immediately to the nurse. If the child is assigned to sight conservation this teacher will of course try to ascertain the etiology by contacting the school or private ophthalmologist. She will then lessen the amount of close eye work, substitute typing and talking book periods for some eye work periods and otherwise lessen the strain on this child.

Styes also may be the result of refractive errors which have not been corrected. They may appear in crops like boils. Often they are the signs of a local infection or of a generalized run-down condition or chronic disease. When frequent and untended, they may finally cause some distortion of the lids and permanent loss of eyelashes. Unregulated treatment may tend to spread the infection from one place to another.

"Common pinkeye or conjunctivitis of children may be a temporary, harmless affection as far as permanent injury to the eye is concerned, but it may also be indicative of a serious disease. In the average mild case the eye usually burns and itches and cannot stand strong light. It is red, watery, usually discharges pus, and as a rule, is not painful. What is not sufficiently appreciated is that this is always a contagious affair, no matter how painless or harmless.

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2. Sight Saving Review, Charles A. Hargitt, Vol. VI., June, 1936, Eye Conditions Prevalent in the Pre-School Child.

Almost always it spreads to the fellow eye, and may be passed on to a whole classroom if care is not taken. After competent medical examination treatment is simple."

Trachoma is a much more serious type of pinkeye. It is estimated that half the world is affected by it. In countries such as Russia, Poland, and China half the population bears its scars. Our immigration officials have been very watchful, but according to Sidney Fox[3] they did not start soon enough. He says, "It is too bad that the officials were not on the 'qui vive' when Columbus landed, because, according to one belief his sailors are responsible for its wide prevalence among the American Indians! In some tribes as high as 35% of the members are infected. But it is also found in some portions of our native non-Indian population, especially in a few of our midwestern and southern states and along the sea coasts." In one midwestern state where there is a large Russian settlement many of the school population are affected. It can be seen by this that as teachers we should be familiar with this disease and its prognoses. It is a disease associated with dirt and squalor and highly contagious. The eye becomes teary, a purulent discharge is common, and an early, typical sign is the drooping of the lids. Unless treated early, trachoma leaves ineradicable marks on the eye after it is finally controlled. All over the world there are adults with distorted lids and poor vision because of trachoma. In the early stages treatment is effective. In the moderately advanced stages about 60% can be helped. If we find any child in our school with this we should not only report this child to the nurse but report the family to the public health department. Help should be given the family if it is impossible for them to pay for treatment. The child suffering from

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3. Sidney Fox, Your Eyes, Alfred Knopf, New York, 1944, p. 167.

this should be watched on the return to school and care taken to aid his readjustment to his group.

Occasionally a child is seen with a so-called "cold in the eye" which is not the ordinary conjunctivitis but may be the result of gonorrhea and syphilis. The former is the cause of 15% of blindness in this country.

Acute inflammation of the conjunctiva in the new born, caused by the gonococcus, is called ophthalmia neonatorum. It occurs generally the second or third day after birth, never after the fifth. The disease is acquired by the infant as it passes through the birth canal or is due to unclean handling soon after birth. The dangerous consideration is that when neglected it affects the cornea and impairs vision. Eyes of the newborn babe do not secrete tears, so that if a watery discharge is noticed it is a symptom of ophthalmia neonatorum. Many states in this country and many countries all over the world have passed laws making it mandatory to carefully wash the eyes of infants immediately after birth and to instill a one or two percent solution of silver nitrate into each eye. Up until 1879 this caused 31% of all the blindness in institutions, but now it is 1/2 to 1%. The prognosis is good if treatment is started immediately. (The treatment now most effective is with penicillin and/or one of the newer mycin drugs--eg., amermycin, terramycin, etc.) If not, there may result an infection of the cornea causing corneal ulcer; this may be followed by inflammation of the whole uveal tract.

Abnormal eye defects which are present at birth may be divided into (1) those congenital abnormalities not compatible with any vision; (2) those conditions present at birth which demand immediate attention but in which the prognosis is poor; (3) ocular defects which must be recognized early in order that visual acuity may be developed; (4) ocular defects where there is partial vision which may deteriorate to

blindness; (5) defects which develop and then remain constant during life; and finally (6) those in which the vision is seemingly good and then the eye undergoes degenerative tendencies.

The first group which includes congenital phthisis (shrunken eye), congenital ectasia (bulging anterior part of the eye), and complicated congenital cataract are obvious at birth. There is some light perception but no sight. The child who is so affected may be enrolled in the Braille class and as such may be assigned to some regular classes where there is a cooperative program. He should be accepted not as a "handicapped child" but as a child, first, who has a handicap. He must be aided to accept this and to make a healthy mental adjustment. The positive philosophy of the teachers and some of the pupils will aid him to make this adjustment.

The second group which, if not given immediate attention, may also become blind includes congenital glaucoma. The first symptom or manifestation of it, if it is not already well advanced at birth is in the gradual but eventually marked enlargement of the globe (buphthalmos) (ox-eye). It is usually bilateral. Then there becomes evident a bluish or slate-colored hue to the white of the eye, because the black pigment layer shows through the thinned white scleral coat. In the later stages, the cornea becomes irregularly bulging and opaque. This deforming of the eyeball is due to the fluid over-distention of the globe before the supporting walls are well developed and strong enough to withstand the tension. It is probably caused by an anomalous anatomical development which prevents the normal drainage of the intraocular fluids which are constantly being formed. The prognosis is poor unless immediate surgical treatment is given. Even if the eye be blind, if the extreme malformation has not progressed too far, proper

treatment may prevent the later necessity of removing the eye for cosmetic reasons.[5]

Among the ocular defects which must be recognized early in order that visual acuity may be developed is congenital cataract. Cataract is a disease of the lens of the eye, in which the normal transparency gives way to a developing opaqueness. It is caused by the failure of the contents of the lens to remain clear in prenatal stages. It is not uncommon to find a number of children from one family group in a class for the blind or in a sight conservation class because of this difficulty. The treatment differs from that used in senile cataract. In some types the contents of the lens is not hard and opaque as in the senile type but soft and cloudy. This requires an operation called needling, by which openings are made through the lens capsule. The lens swells and protrudes through this opening, parts falling into the interior chamber of the eye where they are absorbed by the aqueous. Usually several needlings are necessary. Often the results are so good that with compensating glasses cataractous children are able to carry on their work in regular grades. In other cases the lens material is only partly clarified and vision is definitely affected. This pupil may carry on work compatible with his difficulty and no special care has to be taken except to watch for fatigue. The sight conservation teacher will give him special attention as regards amount of light necessary and advisable for different tasks and will transcribe material for his use.

Next in the group of ocular defects are those in which there is partial vision but which may deteriorate to blindness.[6] The first of

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5. Eye Conditions Prevalent in Pre-School Age, C.A. Hargitt, M.D. Bureau of Services for the Blind, New York City, 1936.

6. Hatha way, Winifred, Education and Health of the Partially Seeing Child, Columbia Press, New York, 1947, p. 172.

these is aniridia or congenital absence of the iris. The visual acuity is never good. The prognosis is almost uniformly bad. In fact, glaucoma often results. Occasionally the patient may have 20/200 vision.

Another of these anomalies is ectopia lentis or dislocation of the lens, present at birth. The lens is most commonly dislocated upward. The patient in this case may have monocular diplopia. This also is subject to complication, especially glaucoma. The vision may be very low.

Among those defects which develop and then remain constant during life one finds albinism. This is a recessive trait which is simply a lack of pigment. Albinos are almost always high myopes (extremely nearsighted). The macula is undeveloped and there is always some nystagmus with, of course, great sensitivity to light. With incomplete albinism the patients always make good use of what vision they have. The teacher must show great care in the seating of these pupils, carefully controlling all light, especially on the working surfaces. Short study and reading periods should be alternated with periods of eye rest such as typing, talking book and music appreciation. The teacher must have rare tact and understanding to help these children adjust in their contact with others. She also has a job to do in the rest of the school population and the teachers to understand the condition and accept it as one variation in the general pattern just as blindness is. They are always exceedingly sensitive about their hair and eyes. Boys can help the hair situation by much hair oil! Personally, I always try to make the girls proud of what I call their platinum blond hair and encourage them to take care of this. I stress grooming particularly with this group.

Retinitis pigmentosa is one of the anomalies in which the vision is seemingly good but the eye undergoes degenerative tendencies. This is the most marked form of night blindness, a true organic disease associated with pigmentary degeneration of the retina. The malady is chronic and progressive, gradually terminating in blindness not only at night but all the time. It first manifests itself in early childhood when the patient complains of poor vision at dusk. A careful history invariably establishes the hereditary nature of the disease and usually consanguinity in the antecedents. The field of vision gradually becomes contracted although central or reading vision may remain good for a long time. With rare exceptions retinitis pigmentosa affects both eyes.... Ophthalmoscopic examination of the fundus shows the pigment clumped in little jet black masses with spiderlike projections. A great many measures have been tried to check retinitis pigmentosa. Hormones, liver extracts, vitamins and X-rays are but a few of the methods but none has affected either an arrest or cure. At present we have no cure for this disease. Whenever the etiology of a disease is unknown there are always countless remedies and no cures, especially if the malady is chronic and progressive.[7] I have quoted a well-known ophthalmologist at length on the disease as it is one of the most important to understand from the standpoint of the sight conservation class teacher. Every sight conservation class has at least one pupil with retinitis pigmentosa. It is most important that the teacher contact the attending physician and follow his directions carefully. She should be aware of the progress of the disease, the medical history of the child and the ophthalmologist's recommendations. As a rule it is recommended that the curriculum be enriched in every way possible while the child has vision. His good mental health must

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7. Schwartz, Louis H, Your Eyes Have Told Me, Dutton Co., New York, 1945, pp. 135-138.

at all times be the goal of the teacher. As his field of vision lessens she must aid him in every way in her power to adjust himself to his handicap and to accept it. A happy, healthy atmosphere must at all times exist in the sight conservation classroom but particularly for the pupils who are losing their sight it is most important. He should be given much help in the technics of getting information through the ears and making use of all equipment such as the typewriter, the talking book, and the tape recorders. Lastly she must help him to plan toward a choice of vocation which will fit his needs.

Interstitial keratitis is another disease which, although it may not be noticeable at birth, is congenital and if not cared for may cause blindness. Inflammation of the cornea is known as keratitis and in all forms the cornea becomes cloudy. This is especially marked in interstitial keratitis, which is usually due to congenital syphilis. This affects children usually around the age of puberty. A very good description of this disease as it attacks children is to be found in Your Eyes Have Told Me by Louis Schwartz.[8] He tells the onset of the disease as it affected a boy whom he calls Johnny. This disease remained active a year and when it subsided it left many scars in the cornea, irregular pupils due to adhesions and dark blotches inside the eyeball. Vision was reduced to one-fifth. For the rest of his life Johnny's eyesight would be poor, in spite of years of treatment. By way of parenthesis, we would say that ocular tragedies caused by syphilis are many; crossed eyes due to paralysis of the extrinsic muscles; double vision; dropping of the upper lid with inability to open the eye; iritis followed by fixed pupil or even exclusion of the pupil due to membrane formation, vitreous opacities, hemorrhages of the retinal arteries and veins with partial

8. Schwartz, Louis, Your Eyes Have Told Me, Dutton Co., New York, 1945, pp. 33, 48-50.

or total blindness and atrophy of the optic nerve.

In the case of interstitial keratitis, or any of the above for that matter, great care should be taken by the teacher to keep in close contact with the nurse and attending ophthalmologist, being careful to follow the directions given and to check with the nurse or social worker to see that treatments are being taken care of as scheduled. Every sight conservation class will have at least one of the above mentioned and sometimes several. The teacher herself should be informed as to the prognosis. It is her special care to guard the mental health of the child, especially the adolescent who finds out for himself the etiology of his handicap. To help him adjust to this disease which is not of his choosing and to help him to adjust to his family if he is old enough to have been told the cause is a job which calls for infinite wisdom and understanding. It is very difficult for a physician even to keep knowledge of the type of treatments from a 15 or 16 year old girl or boy. One of the hardest jobs I have had to assist in was helping a boy of 16 "find himself" during a time like that just mentioned. He was a fine lad who later became a physician himself and is now directing a well-known hospital in the south. Not all such young folks make so fine an adjustment.

Of the diseases mentioned above the sight conservation class teacher may find in her classroom pupils with congenital cataract, albinism, retinitis pigmentosa, optic atrophy, and interstitial keratitis as well as some of the other diseases. It is these diseases particularly with which she must be familiar. She must have in mind the particular adaptations of curricular content, arrangement of physical surroundings, and length of study periods for each. She must

know each pupil and his family well. Her job is not only to help the pupil adjust to his handicap, but to assist the family to surround the child with a happy environment so that he has security in the family group.

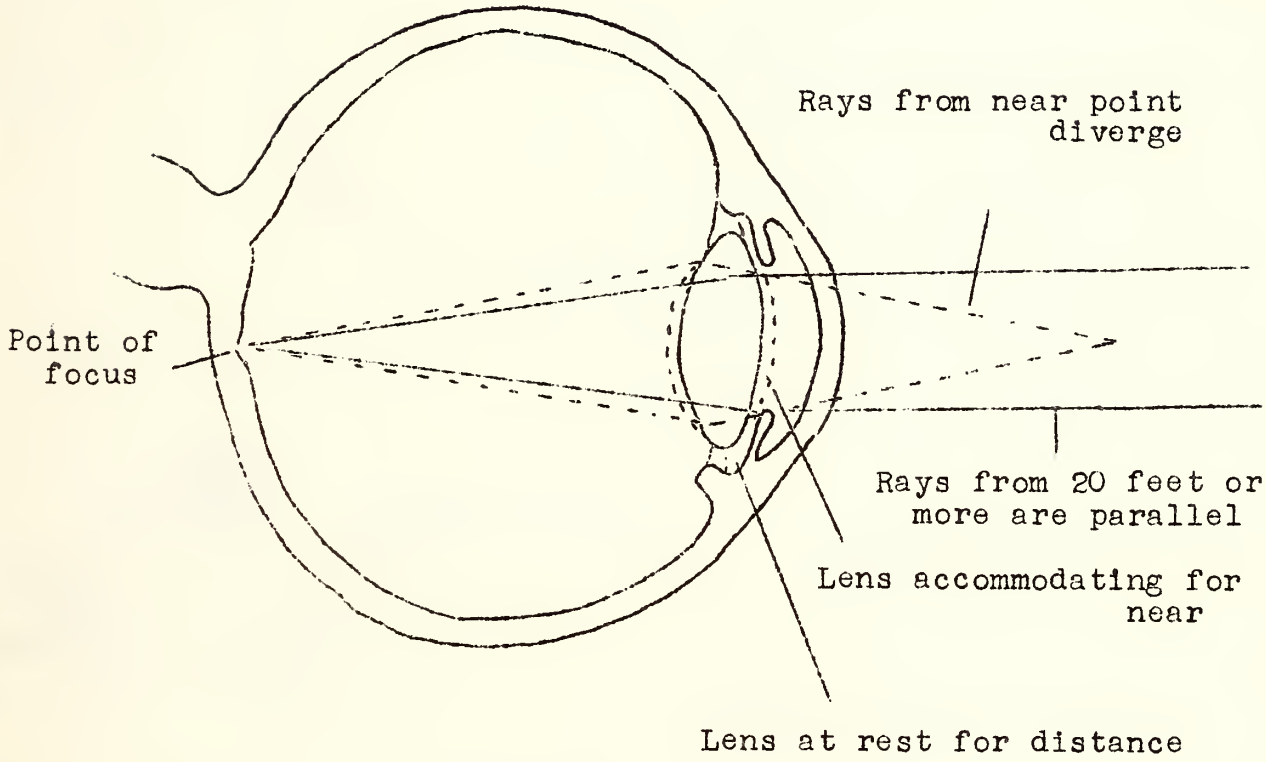
It goes without saying that one part of her job is to see that the child is accepted as a regular member of the larger group in the school, that he is assisted in making worth-while contributions in his classroom and that he feels a part of the extra curricular as well as curricular activities.

It is a wise teacher who has so well adjusted herself that she can have each pupil's background and medical history in the back of her mind guiding her as she helps the child, but never in evidence either with the child or his family except when aid is requested. It is such a teacher who can create a wholesome, happy environment when the child knows he is understood and where he has security.

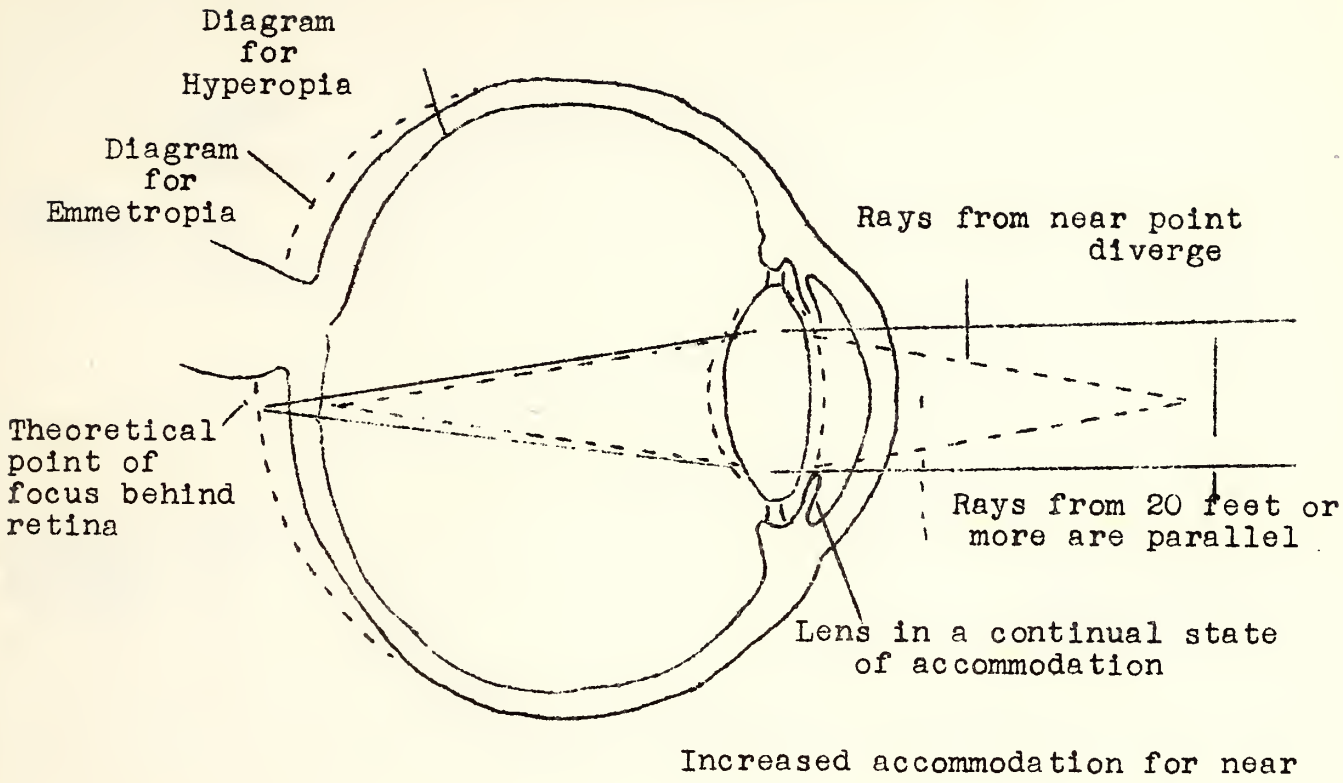
Retrolental fibroplasia is a condition of increasing importance today. It is seen in premature babies, usually under two pounds at birth. An inflammatory process of the peripheral retina causes retinal degeneration and detachment is eventual. A membrane is found behind the lens. Glaucoma usually follows in the severe cases. Much research has been done lately on this condition since it seems to be increasing in frequency but as yet the cause, and therefore the treatment also, is unknown.

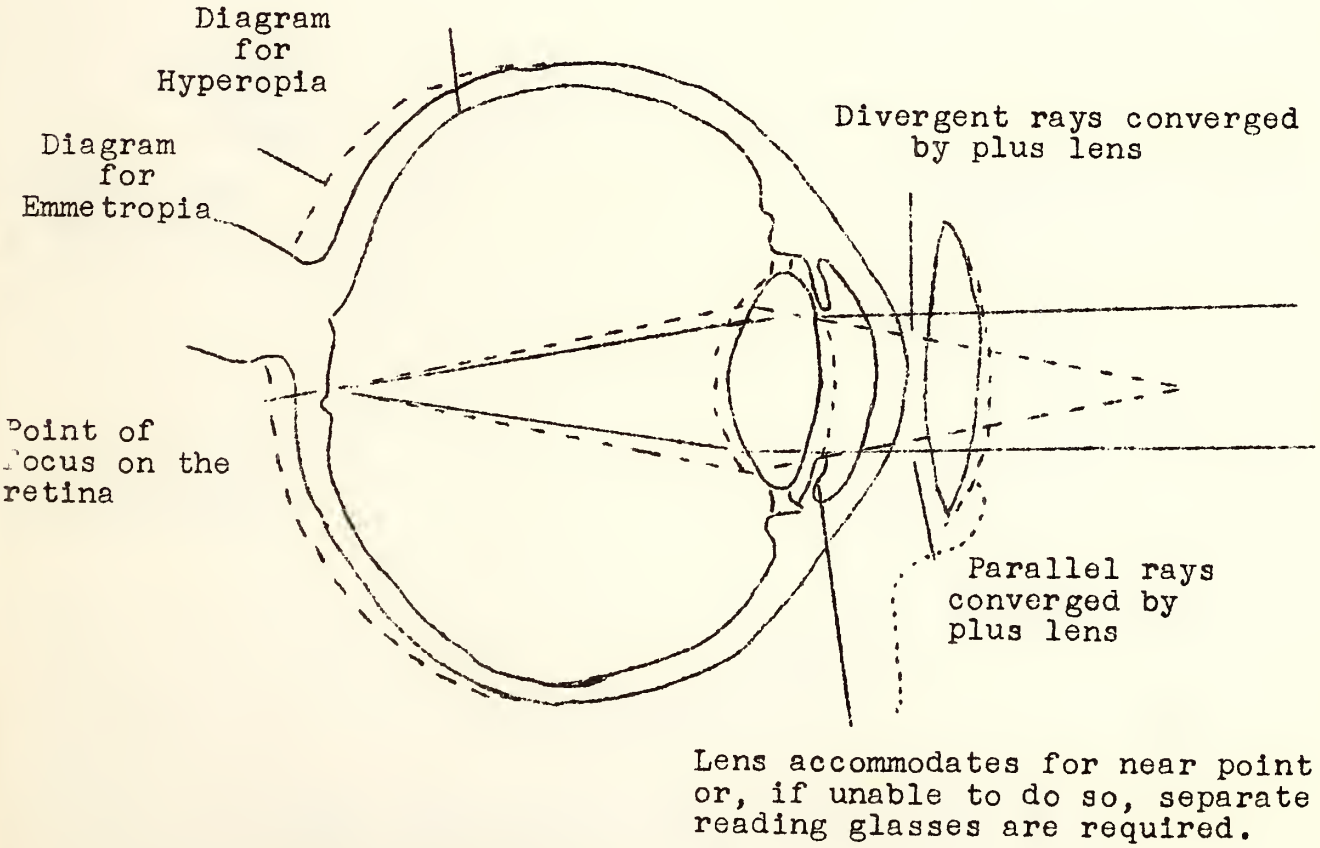
The Emmetropic Eye

AT REST AND IN ACCOMMODATION



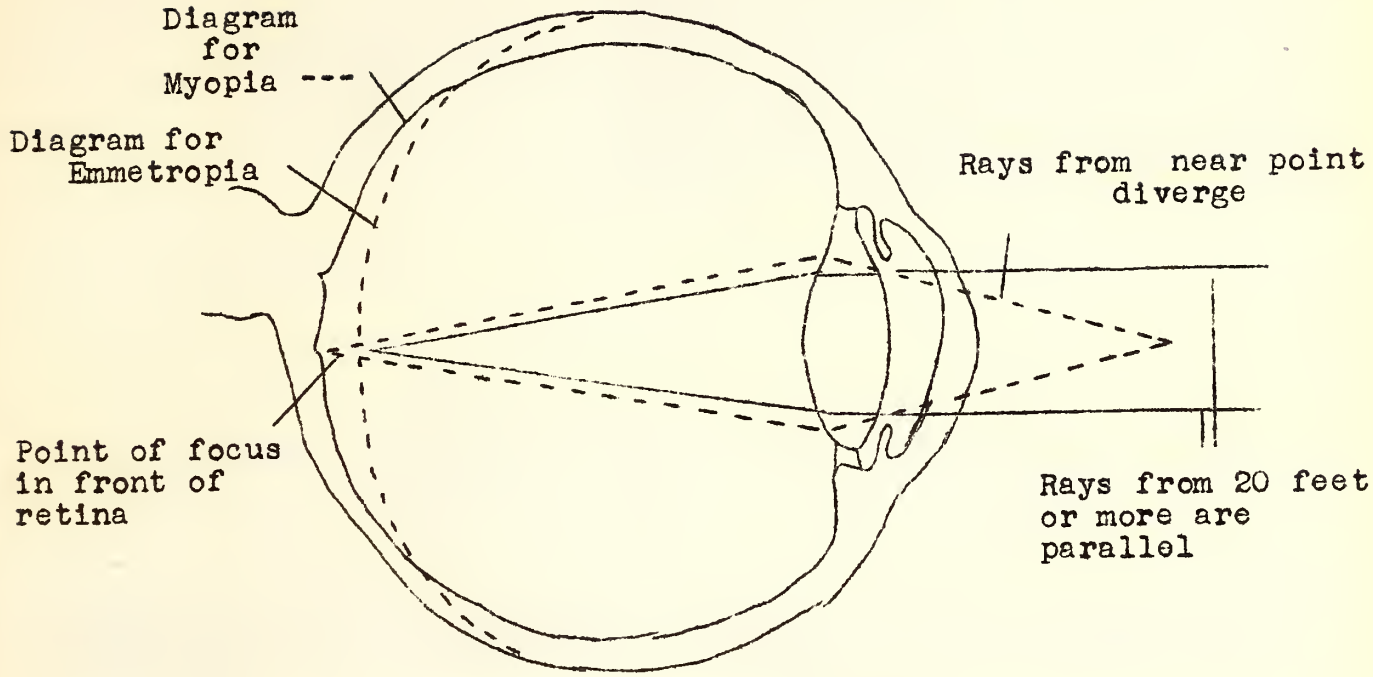
The Hyperopic Eye

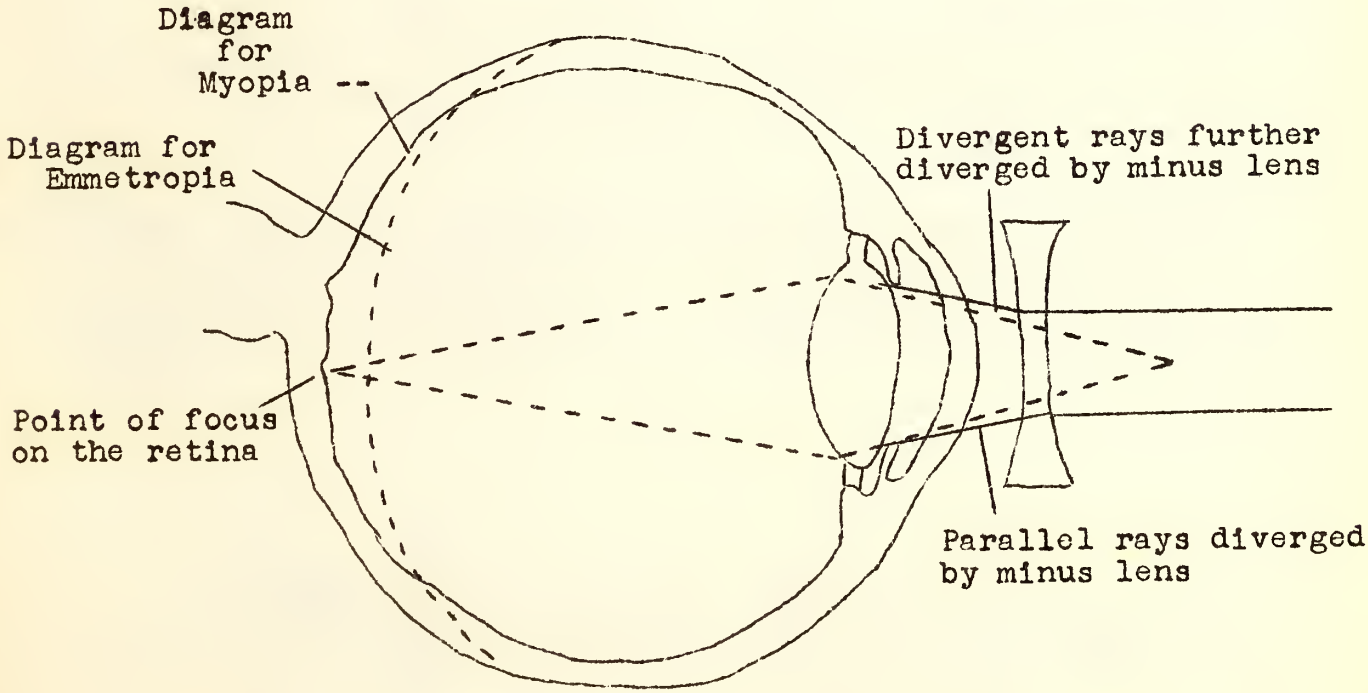




The Hyperopic Eye Corrected

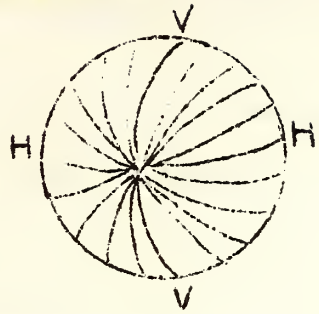
The Myopic Eye





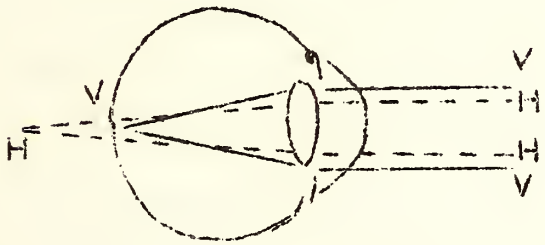
The Myopic Eye Corrected

ASTIGMATISM

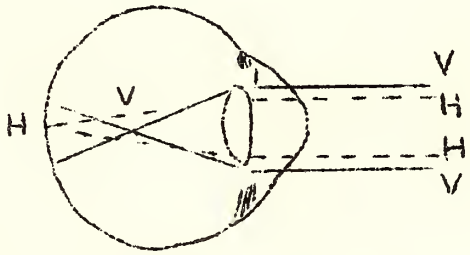


1. Meridians

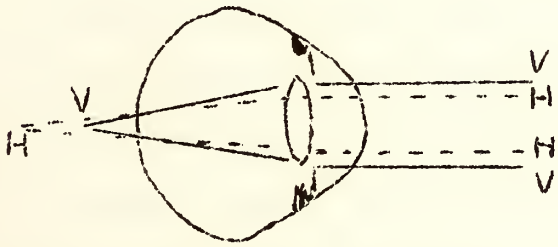
The refractive power of the eye is measured in the various meridians. The principal meridians are the vertical (V) and the horizontal (H). Normally the greatest curvature is in or near the vertical meridian and the least curvature in or near the horizontal. In astigmatism, a single point of focus cannot be obtained for all meridians because of increases or decreases beyond the normal curvature of any meridian.



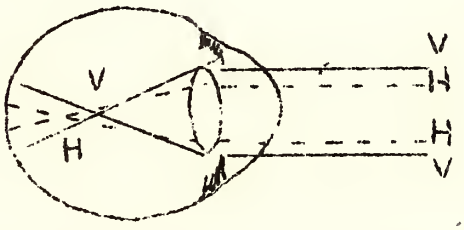
2. Simple hyperopic astigmatism
   Emmetropia in one principal meridian
   Hyperopia in the other



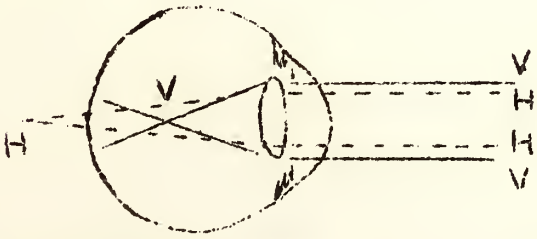
3. Simple myopic astigmatism
   Emmetropia in one principal meridian
   Myopia in the other



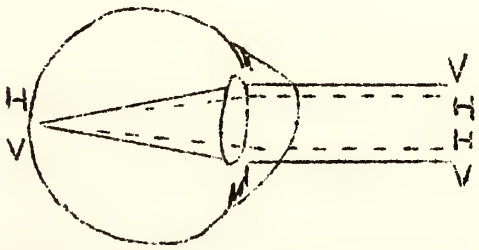
4. Compound hyperopic astigmatism
   The eye is hyperopic and there is hyperopic astigmatism.
   Both principal meridians are hyperopic but in varying degrees.



5. Compound myopic astigmatism
   The eye is myopic and there is myopic astigmatism.
   Both principal meridians are myopic but in varying degrees.



6. Mixed astigmatism
   One principal meridian is hyperopic, the other myopic.



7. Astigmatism corrected with cylindrical lenses to bring all the rays to a single point of focus at the retina.

CHAPTER IV

VISUAL DEFECTS WHICH AFFECT VISUAL ACUITY

The eye is a very complicated optical instrument, but for practical purposes it may be considered a condensing lens which converges the rays of light that pass into it and focuses them upon the retina.

The process of bending the incoming rays of light so that they fall on the retina and give a clear visual image is called refraction.

There are certain principles of refraction which will aid in understanding how the eye functions to bring rays of light reflected from an object to a focus. Since the eyeball is spherical in shape, the chief refractive media through which rays of light pass, the cornea and the lens, are convex, and in the normal eye rays of light are brought to such a focus by these refracting media that the image of the object from which they are reflected falls directly on the retina. When an object within the range of vision is 20 feet or more distant from the eye, the rays of light reflected from it are parallel; hence the lens in the normal eye does not have to change its curvature. The ciliary muscle, which controls its curvature, is therefore at rest.

When, however, an object is close to the eyes, rays of light reflected from it are no longer parallel but divergent. The chief refractive media of the eye, being convex, change their direction to convergent rays, but unless the curvature of some of the refracting media is increased, the image of the object will not be reflected on the retina.

The lens is the only refracting medium within the eye that can change its curvature. When it is increased by the action of the ciliary muscle the rays of light are bent sufficiently so they are brought to such a focus that the image of the object is reflected on

the retina. The power of the lens to accommodate its curvature according to the distance of the object from the eye is called "accommodation."[1]

In the emmetropic or normal eye the parallel rays of light (those from a distance of 20 feet) are brought to a focus on the retina without the use of accommodation. The size and shape of the eyeball influence its refractive powers, the most important aspects being the length of its axis from front to back and the curvature of the cornea and the lens. The typical emmetropic eye is usually 23 millimeters (about 7/8 of an inch) in depth.

In the majority of cases this ideal condition does not exist and because of some defect in the optical system the image cannot be focused clearly on the retina, or the focus cannot be maintained for varying distances. This condition is described as an error of refraction, or ametropia. The ametropic eye is one in which there is a refractive error because it deviates "away from" the normal or emmetropic.

Ametropic eyes are of three types: hyperopic, myopic, and astigmatic. They can usually be given compensation for their errors of refraction by the placement of lenses in front of the eye. The strength of these lenses depends upon the amount of deviation. "These defects in significant amounts put a strain on the individual, either because of the effort to see clearly or, if a clear image can be obtained at one distance and not at another, because there is a tendency to concentrate on activities at the most comfortable range, to the neglect of those which cannot be seen distinctly. The term "eyestrain" is not a desirable one with which to describe the symptoms of such defects. In many instances the strain is muscular or nervous and,

1. Hathaway, Winifred, Education and Health of the Partially Seeing Child, Columbia University Press, New York, 1947.

according to popular conceptions, such strains are believed to be the cause rather than the result of the defects."[2]

It is this statement which makes the role of the sight saving class teacher an arduous one, but most challenging. Each refractive error carries with it idiosyncracies and compensations which call for unique adaptation of materials, reorganization of the physical environment and understanding of the underlying psychological implications of each deviation. As the description of these deviations are given one must try at all times to formulate his own hypothesis as to the procedure he would deem most favorable.

A frequent eye defect is hyperopia or "farsightedness." In this defect the eye is too short from front to back, thus the point of focus for parallel rays of light is behind the retina. To obtain a clear image, some degree of accommodation is needed even for distance seeing, and a greater amount for close work. The so-called "farsighted" eye does not even see distant objects as clearly as does the normal eye. "Rays of light become parallel when they are reflected from a distance of 20 feet or more from the individual. Normal eyes do not have to accommodate in order to see distant objects and are, therefore, at rest. The hyperopic eye, however, experiences no such rest period, since its ciliary muscle is constantly working to try to increase the curvature of the lens sufficiently to give a correct focus, and considerable strain or fatigue may result."

Where there is marked hyperopia and where there is less but with indications of strain, compensation for the difficulty is made possible by placing in front of the eye a lens similar in shape to that in the eye, thus helping the crystalline lens to overcome the difficulty. Such a convex lens is called a plus lens. This brings

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2. National Society for the Prevention of Blindness: Eye Health, A Handbook for Nurses, Nat'l. Society, New York, 1946.

the rays of light to a focus, so that the image of the object will be reflected on the retina of the foreshortened eye.

Hyperopia sometimes causes strabismus, or squint, due to the fact that viewing objects for close work necessitates convergence as well as accommodation. These two functions have a close psychological association. Stimulation of one tends to stimulate the other. Since the hyperope must accommodate continuously, there is a tendency to overconverge.

Children are normally hyperopic, a point which needs to be considered in planning any activities requiring close use of the eyes. In the kindergarten, first and second grades, periods of close visual work should be very brief. Throughout all the elementary grades, periods of close work should alternate with activities in which the eyes are used for grosser seeing or for looking at distant objects. The fact that young children are hyperopic contributes to their lack of interest in activities requiring prolonged use of near vision. In the case of a marked degree of hyperopia the child is assigned to sight conservation class. He generally comes to the class greatly retarded in reading and all the teacher's ingenuity will be necessary to encourage the required and allowed amount of study. He can be programmed for a full gym period. He will generally excel in this due to his interest in all outside activities.

In myopia, commonly called "nearsightedness," the eyeball is too long from front to back. Thus, the parallel rays of light reach a focus in front of the retina. As the eye has no mechanism for overcoming this, the object must be brought nearer to the eye, where the rays of light will be sufficiently divergent to be focused on the retina so that the object can be seen clearly. In order to obtain a focus farther back, where the retina of a nearsighted eye is, it is

necessary to place in front of the eye a lens differing in shape from the crystalline lens, namely, a concave lens, which will diverge the rays of light. This type of lens is called a minus lens, because it decreases the refracting power of the eye.

While myopia in the newborn is a rare exception, it is found in over 10% of children in primary grades; and between the ages of ten to twenty it has increased to about 20%. Some ophthalmologists today believe that the biological normal in man is shifting from farsightedness and that a permanent degree of low myopia is not pathological. They consider that myopia may be due to our eyes trying to adapt themselves to our new method of living--as frequently happens in nature. They consider that it is a developmental condition, namely, one of several refractive types.

The exact cause is not known but we do know that increasing myopia is most commonly found during early school years. We do know that there is a tendency for myopia to progress up to the eighteenth or twentieth year and then to remain stationary. The hereditary tendency is a strong one.

"By comparison with the headache and eyestrain commonly found in the farsighted individual, the problem of the nearsighted person is simple. He just does not see well. The farsighted eye may improve its near vision by accommodating, but the nearsighted eye cannot. His bad luck lies in the fact that once having become myopic, he remains so to the end of his days. The only possible change is more myopia."

The nearsighted child lives in the center of a much more closely encircled world than the child with normal eyes and he deserves early and competent assistance if he is not to be handicapped in this highly competitive age. "Because distance vision is not clear, such a child tends to develop unusual interest in activities performed at close

range, often sustaining attention on them over a longer period than is common with children of his age. He may become overly fond of picture books and want to learn to read before he is mature enough. This absorption is likely to have far-reaching results."[3] Because he does not like outdoor play, due to the closeness of his world about him, his muscles may not develop well and general nutrition may be poor. The poor posture, due to bending close over his work or play has its effect on his development. The difference in his interests and those of most children tends to isolate him. Although he is often a very good student, he may be a lonely child. It is the task of the sight conservation class teacher to help him to engage in those outdoor games which are possible for him, to encourage him in running, hiking, climbing and rhythmic games and dancing. He should have some chance each day to participate in outdoor play which he enjoys. Great care should be taken with the amount of light on the working surfaces because he usually has a larger pupil than the hyperopic child, hence, more light gets into his eyes and he is annoyed by the strong light and glare. Where there is a high degree of myopia present, the child and his family should be made aware of the danger of detachment of the retina. "Because of elongation of the eyes from front to back, the retina may become thinned or the vitreous material may shrink and thus pull the retina away from its attachment to the choroid. Any very sudden action, like diving, may cause the thinned retina to tear. Sometimes a blow or a fall will cause detachment. Any sudden decrease in vision always indicates the need for immediate examination of the eyes. The teacher must tactfully explain this without causing undue alarm. In the case of a junior highschool boy who is told he cannot play football nor dive in the swimming pool the teacher has a real

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3. Eye Health, A Teaching Handbook for Nurses, National Society for the Prevention of Blindness, New York, 1946, p. 66.

task to guard his mental health and have him make a healthy, happy adjustment.

Irregularities of the curvatures of surfaces of the lens, or more often of the surfaces of the cornea, produce the condition known as astigmatism. One of the two main meridians at right angles to each other is usually affected, but the error may occur in any meridian; a type of lens must be used that will correct only the affected meridian. A spherical lens cannot be used, because it corrects all meridians. A cylindrical lens must be used, since it corrects in one direction only. When a cylindrical lens is prescribed, the meridian affected must be designated and the lens must be placed in the frame at exactly the position indicated. Differences in temperature may cause a frame to expand; a round lens may become turned in the frame, in which position it not only fails to correct the error but places a correction on a normal meridian, thus causing two deviations."[4] To avoid this, an elongated lens is used. Care must be taken that glasses are straight. This would also alter the correction. A significant amount of astigmatism results in a blurred or distorted image which the person tries, ineffectively, to overcome through adjustments of focus, narrowing the lids and contracting the pupils. These continuous, futile efforts cause strain, fatigue, and often headache and general discomfort. This is the most common and annoying of abnormalities. Yet "abnormalities" is not the precise word, because the majority of people are astigmatic. It has been estimated that astigmatism combined with hyperopia or myopia causes three-fourths of the functional headaches due to close work."[5] Simple astigmatism is always hyperopic or myopic, but it may be associated with refractive errors of the whole

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4. Winifred Hathaway, Education and Health of the Partially Seeing Child, Columbia Press, New York, 1947, p. 16.

5. Sidney Fox, Your Eyes, Alfred Knopf, New York, 1946, p. 28.

eyeball which may be either the same type as the astigmatism or an opposite type. If of the same, it is a compound hyperopic or myopic astigmatism; if of the opposite type, it is a mixed astigmatism.

Another important deviation from the normal is imbalance of the extrinsic or external muscles, the six muscles holding the eyeball in place. A deviation which is not apparent, but latent, is called a 'phoria', a marked deviation a 'tropia', and manifests itself in some form of strabismus or squint (crossed eyes). When an eye begins to deviate, two images are seen because the eyes no longer are in a parallel position. This makes fusing of the images impossible. Diplopia (double images) is very annoying and not long tolerated by the mind. Suppression of the image in the squinting eye soon takes place. One eye may be used continuously, as above, or either eye alternately. This latter is known as alternating strabismus and the sight may remain equally good in both eyes. Strabismus is most likely to become obvious at about two or three years of age, but if noticed earlier, the child should immediately be placed under the care of an ophthalmologist. The consensus, at present, is that for maximum results treatment should be started before the end of the sixth year. The first step in treatment is refraction. If any error is present in either eye, glasses are ordered for constant wear. The second step is occlusion. The only way to force a child to use an amblyopic eye is by covering the good eye until the weak eye is developed. Occlusion must be constant. A moleskin patch may be used. After the vision has reached 20/50, the moleskin patch can be replaced by a patch on the lens of the glass. When vision is equalized, occlusion is made partial, either several hours a day or certain days in the week. If good vision can be maintained in each eye until the age of ten, when visual development is certainly complete, little deterioration will

then occur. This is one place where the sight conservation class teacher will have to prepare the other children in the class, the regular class pupils, teachers and the parents so that all may have a positive, constructive, helpful attitude. The child must be watched for nervous fatigue and pleasant tasks in the room given him so that he will not have any sustained eye work at first. The acceptance of occlusion by a child is influenced by the attitude of his parents, the adults and other children; in general, young children are less likely to be sensitive about this than older children.

Even if occlusion proves successful, it will have given the child only two good eyes. It has not enabled him to use them together. The next step, then, is the development of binocular ability. This is done by special exercises, known as orthoptics, and should be given by an eye specialist or by a trained technician working under his direction. Again, cooperation of both child and parent is enlisted and treatment periods may be supplemented by recommended visual activities at home. In some cases surgery is necessary, but, on the whole, early care tends to lessen the need for operations. If surgery is needed, it will aid single binocular vision most if performed before the sixth or seventh year.

Not only is a "crossed" eye likely to become a useless eye, but also it is so disfiguring that it may affect the emotional and social life of the child as well as his educational processes. It is recommended from a cosmetic or psychological point of view that deviating eyes of older children or adults be straightened even though binocular vision cannot be achieved. The sight conservation class teacher who will have several of each of the above in her class will realize the nervous strain the child is under and at all times provide in the sight conservation class room a place where he may have release from all tensions, a quiet happy environment and a feeling of security which will be reflected in the maximum efficiency of his visual apparatus and his own mental health.

CHAPTER V

THE TESTING PROGRAM

California House Bill 16482 states that each school district shall provide for testing of the eyesight of all school children. The statement has been made that 20% of all school children have some eye defect. Granted these two statements, the testing program to determine the need, followed by an attempt to understand the influence of deviations from the normal on the complete picture of the child, becomes an important item in the educational set up.

The testing program has been taken care of in various ways in different communities. In some cases the attending ophthalmologist makes the recommendation and requests placement in the sight conservation class. In rare cases there is a school ophthalmologist who examines the eyes of all the school children. This would be the ideal procedure. In one instance, in the state of New Jersey, a mobile unit tours the state in the summer, examining the eyes of all school children and making recommendations to the schools. This was sponsored by the P.T.A. In some instances there is a school eye clinic with a part-time ophthalmologist employed who examines those children recommended either by the teacher or the school nurse.

However, even if this last is the case, in the majority of cases the first or "screening" test as it is called is made by the school nurse. In some instances there are no facilities provided and the teacher must conduct this "screening" test herself and make recommendations to the health department.

The important item under any of these circumstances is that the responsibility for the screening program is primarily the responsibility of the school health service. "Delegation to a teacher or to any

other worker does not relieve the health service of the responsibility for insuring correct techniques and for guiding and supervising the program. Preparation for giving the tests should include (1) a working knowledge of the general structure and function of the eyes; (2) the ability to recognize obvious symptoms of eye difficulties; (3) an understanding of the general principles underlying the test; (4) an appreciation of the psychological factors involved; and (5) the importance of and reasons for following standard techniques. Demonstrations and practice testing, as well as discussions of the significance of the findings should be an essential part of the preparation."[1]

The test most universally used to test visual acuity is the Snellen. Included in this test are charts with test objects, symbols, letters, or numbers of graded size. These are read from a distance of 20 feet. The objects are graduated in size and constructed according to scientific optical principles. Each size is numbered to indicate the standard distance at which a person with normal visual acuity should be able to distinguish it. Hence, one is said to have "normal" distance central visual acuity if he can see the 20 foot size from 20 feet away. At the same time it must be remembered that such a standard is not always possible for young children, even when their sight is normal. (This is just one argument against the general use of the Snellen by those who are not versed in the general structure, the function of the eye, and also its development.) Merely the statement 20/30 or 20/50 means nothing to the discriminating worker who knows that this is but one part of the picture which should be interpreted as a whole.

For convenience, the results of the test are expressed as fractions, the numerator indicating the distance from the chart, the denominator,

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1. Winifred Hathaway, Education and Health of the Partially Seeing Child, Columbia Press, New York, 1947, pp. 176-177.

the smallest size objects read. 20/70, for instance, means one reads at 20 feet what one should read at 70 feet.

The chart is place with the 20 foot line of test objects approximately at eye level and should be provided with 8-12 foot candles of light. Room lighting should be adjusted to at least one-fifth the amount on the chart, and should be free from glare and sharp shadows.

The Snellen test shows only the degree of distance visual acuity, without giving the clues to the cause when this is low. Myopia is the one error which can be detected. It is possible with significant amounts of hyperopia to pass the test as normal. An attempt to remedy this has been to use the Snellen Chart, but to provide the pupil with a pair of glasses fitted with a plus 0.75 or 1.50 spherical lens. The ability to read through such glasses is proof that the eye has less than the amount of basic refracting power. This suggests that the student should be watched for evidence of eye fatigue. This is the "fogging" test used to detect manifest hyperopia. A recommendation is made that the student see an ophthalmologist to determine the degree of hyperopia and whether glasses are necessary.

Several types of tests for near vision are available for testing vision at approximately 14-16 inches. Some have printed paragraphs of graduated size and others block letters or symbols drawn to Snellen scale. The Jaeger is an example of the former, while the Reading-Rating Chart of the A.M.A. is of the latter type. As in the Snellen, each eye is tested separately, then both together, with or without glasses.

An additional test might be included under some circumstances to detect the presence of astigmatism of low degree. "This is accomplished by rotating a crossed cylinder (-25 = plus 025) before each eye separately, while standing at the greatest distance from the chart where clear vision is had. Decided differences in visual acuity in

any two positions of the crossed cylinder is indicative of astigmatism. Decided clearing of vision with the cylinder in any position indicates astigmatism of a sufficient degree to call for an ophthalmological examination."[2]

Dr. Schonwald, writing in the Journal of School Health, speaks of his long-felt need for something more adequate than the Snellen Test. He states that the group of students who, in order to make satisfactory reading adjustment although they make 20/20 on the Snellen Test, are the group that the Health Service in any school should help. He says that this group has been passed by in the hope that their difficulty will appear and be recognized before serious damage has been done to either the eye itself or to the academic accomplishment of the pupil. These pupils appear at a Health Service during intensive study programs and request headache pills. They do not, he says, complain of loss of visual acuity, but rather, they are unable to use their eyes for intensive study. Some lose interest in school work, turn to athletics, or stop school entirely. This is almost always due to overwork of the ciliary muscle, which overwork is associated with hyperopia or astigmatism.

Dr. Schonwald suggests a letter test to take the place of the usual Snellen. His specific recommendation is, "Replace the usual Snellen Chart by a small chart having five rows of letters, all of one size, normally visible at 20 feet. Such a chart can easily be illuminated by a single lamp with a reflector, or better, placed in a small cabinet made of thin wood and illuminated by two small bulbs (25 to 30 watts). This cabinet weighs only a pound or two and can easily be made in any school shop for a small cost. Visual acuity should be recorded as the greatest distance in feet from the chart where clear

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2. John De Witt Schonwald, Visual Examination for School Children, The Journal of School Health, April 1948, pp. 99-102.

vision is possible, and where 20 feet is normal. After using this technique for several years, I am convinced that the distance from the chart, rather than the size of the letters seen, is more impressive to the lay mind. When visual defects are reported to the teacher as the greatest distance for effective vision, it has a direct application in the seating arrangement of students in the class room, relative to the distance from the blackboard."[3] This last practical application is an important item in the testing program.

The Navy uses a modification of the Snellen on the order of the test suggested by Dr. Schonwald. It uses the Snellen Chart but the person is asked to read the letters on the 20 foot line only, at the farthest possible distance. If the line is read at 15 feet, the vision is recorded as 15/20; if at 10 feet, vision is recorded as 10/20. In recording these findings the examiner must at all times specify the type of test used so that the findings may be interpreted in the light of the particular test given.

"A rough measure of the extent of peripheral vision can be obtained by the confrontation test. This consists of ascertaining at what point above, below, and to each side of the eye, a person becomes aware of a large pinhead, which is kept in constant motion, and moved in an arc toward the center of the field of vision. Normally, while the pinhead is not seen clearly, its presence and motion are discerned almost as soon as it passes the bony orbital rim from any direction. This, however, varies somewhat with facial configuration."[4]

The above represents a rough screening for reduction in the fields of vision. Any variation from the normal should call for an ophthalmological examination. If the physician charts the fields and finds a

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3. Ibid, pp. 101-102.
4. Eye Health, A Teaching Handbook for Nurses, National Society for the Prevention of Blindness, New York, 1946, p. 43.

reduction, he looks for the underlying cause which may be migraine, brain tumor, hysteria, toxic amblyopia (tobacco-alcohol poisoning), retinitis pigmentosa, glaucoma and optic atrophy caused by syphilis." Physicians rarely, if ever, rely on the perimeter test alone in making a diagnosis, but when it is studied in relation to the evidence collated from all other sources available, the examination of the fields of vision is often the deciding factor in the recognition of a disease which, without it, might have been diagnosed incorrectly or too late."[5]

It is very important to be able to find those children who have some error in muscle balance. It is desirable to test: the muscle balance with eyes looking straight ahead; the ability to converge; and the coordination of the eyes as they rotate. For the first of these, either the cover test or a Maddox's rod test may be used. The object of the cover test is to discover if the alignment of the eyes is maintained when one eye is covered briefly while the other is fixed on a bright object. The Massachusetts Department of Health has developed a device for using Maddox rods for this purpose. This is part of a battery of tests known as the Massachusetts Vision Test. When a light is viewed through the type of lens known as a Maddox rod, it is seen as a streak of light, its direction being determined by the rods of the lens. In the Massachusetts test two pairs of glasses are used, each with a Maddox rod for the right lens only, one to produce a horizontal streak, the other a vertical. The light is set in a small opening in the chart, which is drawn to resemble a house with a light in the window. This house chart is drawn to a definite scale so that if the streak is seen outside of a specific area, it indicates what is considered a significant degree of muscle imbalance. This test is made at 20 feet, and a similar one with a small block and a pin-point

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5. Louis H. Schwartz, Your Eyes Have Told Me, Dutton Co., New York, 1945, p. 149.

of light is made at 16 inches. Convergence can be tested by having the person watch a pinhead slide along the edge of a rule toward the bridge of the nose. The rule is placed with the zero end against the side of the nose, slightly below eye level. Normally, the approaching pinhead can be watched until it is about three inches away, when the eyes will be seen to diverge or the person will complain of seeing double, or of being unable to continue to see it.

Tests for color vision should not be such as to necessitate the naming of colors. As extensive research is under way on the development of satisfactory color-vision tests, it is not possible at this time to make conclusive statements on this subject. However, the two types of tests in use today are (1) colors which must be matched as the Holmgren Wool Test and (2) patterns formed by colored dots which must be distinguished from a background of similar colored dots. This is called the Ishihari Test. Lighting is extremely important in color vision testing.

Great care should be taken by the person doing the screening test that no definite information is given to the pupil to take home. One may indicate in a letter or on a form that some deviation has been discovered and recommend the child see either the family ophthalmologist or the school eye physician. The records of the findings should be kept with the cumulative health record. A follow-up should be made to see if the recommendation has been followed. If not, a request for conference with the parent, the nurse, the counselor, and the teacher should be the next step.

The information sent out with the Massachusetts Test definitely states, "The responsibility of the non-professional person giving the test is to determine which children pass and which fail. The responsibility for diagnosis is placed where it belongs--with the family

eye specialist. Record sheets carry a score for school record and serve as a basis for re-check. The function of the test is (1) to segregate cases in which there is low visual acuity; (2) to detect those who pass the visual acuity test but who nevertheless have eye-strain which may require attention; and (3) to indicate cases in which there is difficulty in using both eyes together."[6]

If the lay people who give the screening tests would remember their responsibility and refrain from reporting specific findings to the child and parent, the medical profession would have a different attitude toward the function of the screening test. Many doctors are in accord with all of the tests listed above. In fact, the Massachusetts Test is acceptable by Council of Physical Therapy of the American Medical Association. However, many are of the opinion that the lay person should use only the Snellen Chart. When all the lay people connected with this very fine undertaking will remember that their responsibility is the finding and referring, the ophthalmologists will soon recognize the worth of complete eye tests for every school child. The person making the survey test should correlate the findings with observation of behavior during the test, plus behavior observed in the classroom. The findings on eye health should be correlated with those on general health and all of this interpreted in the light of the complete cumulative picture, physical, scholastic, and psychological.

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6. Massachusetts Vision Test, Developed by Massachusetts Department of Health, manufactured by Welch, Allyn, Auburn, New York.

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